

GUATEMALA
VECTOR RISK ASSESSMENT PROFILE
(VECTRAP)

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1. **GEOGRAPHY:** **Area** of 108,780 sq. km (42,000 sq. mi.), or about the size of Tennessee. **Cities** - **Capital** is Guatemala City (pop 1.9 million). **Other cities** - Quezaltenango (72,000), Escuintla (87,000). **Terrain** is mountainous, with fertile coastal plain. **Climate** is temperate in highlands; semi-tropical on coasts.

2. **VECTOR-BORNE DISEASES:**

a. **Malaria:** Risk is year-round in areas below 1500 meters (5000 ft) and in all urban areas except Guatemala City. Malaria transmission is highest during rainy season (Jun-Nov). Officially reported annual case totals declined sharply during 1994. *Plasmodium vivax* accounts for more than 98% of detected infections with *P. falciparum* accounting for most of the remainder (*P. malariae* infections also occur). Incidence of *P. falciparum* has been greatest in the northern provinces of Alta Verapaz, Peten, Quiche, and Izabal. Chloroquine/Fansidar resistance has not been reported.

b. **Dengue:** Risk is likely year-round wherever mosquito vector populations occur. During 1995, more than 3,400 cases occurred; dengue viral serotypes den 1, den 2, and den 4 were detected.

Considerable risk is present in urban areas.

c. Other mosquito-borne arboviruses include **Eastern Equine Encephalitis (EEE)**, **Venezuelan Equine Encephalitis (VEE)**, and **St. Louis Encephalitis (SLE)**. These arboviral agents circulate erratically with only occasional incidental human infections. Historically, EEE virus has been isolated from sentinel animals in Peten Department.

d. **Cutaneous Leishmaniasis (CL)** risk is likely year-round. Elevated risk may be associated with increased vector populations from May through November, but most cases are reported during the first half of the year. Most cases are in the northern departments at elevations less than 1,000 meters, with elevated risk in the forested areas of Peten Department. Over 1% of wild-caught *Lutzomyia* species (sand flies) are infected. Many villages in El Peten have reported 50% case rates. *Leishmania mexicana* is the primary agent in El Peten, while *L. braziliensis* foci occur on the southern border with El Salvador. Strains of *L. braziliensis* exhibiting reduced sensitivity to standard antimony (Pentostam) treatment have been reported.

A limited risk from **visceral leishmaniasis (VL)** may exist in the semiarid valleys and foothills of east central Guatemala. The endemic status of VL is uncertain. Apparently undetected in Guatemala until relatively recently, a few cases (presumably caused by *L. chagasi*) have been reported, mostly from El Progreso Department in east central Guatemala.

e. **Onchocerciasis** is present in heavily forested areas between 500 - 1500 meters. Main foci appear to be the Pacific slope of the Sierra Madre and in Escuintla along the Rio Verde and Guachipilin Rivers. Approximately 30% of symptomatic individuals in these areas display ocular involvement due to punctate keratitis.

f. **Louse-borne Typhus** is hypoendemic country-wide. Outbreaks have occurred within the last 10-15 years.

g. **Chagas' disease** has also been reported, but current levels are unclear (6 to 15 percent seropositive rates in serosurveys of rural populations in east central areas. Up to 9 percent of donated blood may be seropositive). Risk may be elevated in the southeast.

h. Potential for **yellow fever** transmission exists in El Peten, but is extremely unlikely due to decimation of Ateles populations there.

3. OTHER THREATS:

a. **Rabies** is enzootic country-wide, and an acute problem in the northern provinces along the Mexican border. Feral and domestic dogs, especially puppies, are at high risk. *Desmodus rotundus*, the vampire bat, is common in Peten and is thought to play a role in sylvatic transmission, but prefers to feed on horses and cattle.

b. **Snakebite** is a serious occupational hazard for agricultural workers and loggers in the northern provinces. By far the predominant species involved is *Bothrops asper*, known locally as "Terciopelo" or "velvet skin". In the U.S. it is incorrectly called "fer-de-lance". It is a large and heavily-bodied snake, reaching a length of 6 1/2 feet. Although normally rather phlegmatic in disposition, *B. asper* may be prone to strike at any movement within reach, if startled. It prefers to position itself alongside fallen logs and other small animal runs. A polyvalent antivenin is produced for this species by the Instituto Clodomiro Picado in San Jose, Costa Rica. It is reputedly more effective than comparable antivenins manufactured at Wyeth Laboratories in Philadelphia or the Instituto Butantan in Sao Paulo, Brazil. The Bushmaster, *Lachesis mutus*, is found only in the densely forested regions and does not figure into morbidity or mortality data in any significant way.

c. As of August 1999, The Ministry of Health confirmed the existence of 5 cases of leptospirosis, a disease transmitted from infected rat urine, in the municipality of Los Amates (Department of Izabal), confirmed by the Director of Epidemiology of the Ministry of Health.

4. DISEASE VECTOR INFORMATION:

Guatemala has a tropical climate characteristic of countries in Central America. It shares borders with Mexico, Honduras, El Salvador and Belize. The Pacific coast area is characterized by savannahs and brackish lagoons called **esteros**. This terrain rises inland to become high plateaus, mountains and volcanoes (some active). The north is characterized by deep river valleys. The El Peten area is a limestone plateau overlain by a dense forest. Heaviest rainfall is in central Guatemala and along the southern mountain ranges on the Pacific coast.

a. Mosquitoes: *Anopheles albimanus* is the primary vector of malaria in Guatemala. *An.*

pseudopunctipennis is a secondary vector.

An. albimanus breeds in sunlit or partially-shaded water collections, pools, lakes, and esteros. Marshes and swamps are of little significance. Breeding sites are generally turbid but not excessively polluted, often with *Spirogyra* algae on the surface. Breeding sites change seasonally, becoming intense and focused during the dry season of November through April. During March and April, rivers, esteros, and irrigation canals reach peak breeding potential. *An. albimanus* will breed freely in water of salt content of less than 13% and has been found breeding in water almost 40% saline. Diurnal resting sites are variable but favor man-made structures. *An. albimanus* rests in sheltered niches between 0200-0900, therefore ULV spraying will be ineffective during this period. During the dry season, biting activity is 1800-2100/0400-0500. During the rainy season this shifts to

2300-0300. It prefers to feed on ungulates, but will opportunistically feed on humans, preferring the ankle area. Peak malaria transmission due to this species occurs during October.

Sampling is best done by human biting collections or CDC light traps modified for updraft and ultraviolet illumination. Intensive agricultural spraying has led to varying degrees of resistance to chlorinated hydrocarbons and organophosphates. Indoor residuals of carbamate wettable powders appear to be most effective due to a fumigant effect. ULV using synergized pyrethroids offers excellent short term control if done at night. DEET is an effective repellent when applied properly and re-applied when needed.

An. pseudopunctipennis is found in many of the same habitats as *An. albimanus* with either species being dominant, however, *An. pseudopunctipennis* predominates in highland valleys. It breeds in shallow pools, seepages, and drying river-beds and is a persistent indoor feeder on humans. It does not rest indoors prior to or after feeding on humans, therefore residuals are ineffective. It is not attracted to light traps. Barrier treatments out to 100m should be effective.

The mosquito, *Aedes aegypti*, is the primary vector of dengue. A secondary vector, *Aedes albopictus*, has become established in Guatemala through the importation of used tires. *Aedes aegypti* is peridomestic and breeds almost exclusively in artificial containers. It breeds throughout the year in tropical climates. It prefers to bite about the neck and/or ankles, feeding in the early morning/late afternoon. It prefers to rest indoors in closets and behind curtains, making it difficult to control with broadcast ULV pesticides. This mosquito may also transmit Yellow Fever.

b. Lice may be a problem among the populace. They can be found in clothing in areas of the groin, armpits, waistline, neck and shoulder blades. Spread of louse-borne typhus is facilitated by crowded conditions and poor sanitation. The body louse, *Pediculus humanus* is the vector of louse-borne typhus.

c. Onchocerciasis is transmitted by black flies, *Simulium* spp. The principle vector is *S. ochraceum*. Threshold biting density for long term transmission is proposed as 1.9/man/hour *S. haematoporum* is a less efficient vector than *S. ochraceum* country-wide, but is an important potential vector in the lowlands, being strongly anthropophilic. *S. metallicum* is consistently taken in greater numbers in coffee cultivation areas than housing. Larvae attach themselves to partially submerged vegetation in rivers/streams that are swift moving, well-oxygenated and rich in nutrients. Adults have flight ranges of 3-4km. Adults appear to have biting periods in the morning and late afternoon, with peak activity between 8 - 10 am. Control is exceptionally difficult due to inaccessibility to the breeding habitat and mid-day activity. DEET is effective, especially in the extended duration, lotion formulation. Pyramid CO₂-baited traps are effective for sampling *S. pulverulentum*. Net traps are efficient at capturing *S. metallicum*, *S. callidum*, and *S. mexicanum*. Neither traps capture sufficient numbers of *S. ochraceum* to avoid using human bait samples.

d. Sand flies of the genus *Lutzomyia* are vectors of Leishmaniasis. *Lutzomyia* spp. sand flies breed throughout the year. Most sand flies are active between dusk and dawn and have a very limited flight range. Presumed vector species include *Lu. ylephiletor*, *Lu. panamensis*, and *Lu. olmeca* for cutaneous leishmaniasis (CL), and *Lu. longipalpus* for visceral leishmaniasis (VL). Peak biting activity occurs between 2300 and 0300 hours. Larvae are found in soil and leaf litter habitats. Adults feed on man, mammals and reptiles. Feeding occurs at dawn and dusk. They are not strong fliers and are active only when humidity is high and wind speed is low. Reservoirs of leishmaniasis include Two- and Three-Toed Sloths. Residual pesticides and dusts applied to burrows, leaf litter and tree trunks can be effective. DEET is effective.

e. Reduviid bugs (kissing bugs), of the genera *Rhodnius* and *Triatoma* are the primary vectors of Chagas' Disease. They are found in thatched-roofed huts and earthen-floored areas and are associated with woodpiles

and stored clothing. Risks of being bit are higher when sleeping in close contact with soil. Feeding occurs at night. The face and surrounding areas of exposed skin are favored feeding sites. Disease pathogens are transmitted by rubbing bug feces into wound sites produced by the feeding insects. *Rhodnius* is the more efficient vector owing to its habit of defecating profusely throughout the feeding process. Control is based upon removal of debris and harborage, residual wettable powders applied to wall surfaces, and use of bednets.

5. DISEASE AND VECTOR CONTROL PROGRAMS:

a. Malaria chemoprophylaxis should be mandatory. Consult NEPMU-2, Norfolk, VA (COMM: 757-444-7671; DSN: 564-7671; FAX: 757-444-1191; PLAD: NAVENPVNTMEDU TWO NORFOLK VA) for current chemoprophylaxis recommendations.

b. Yellow Fever immunizations should be current.

c. The conscientious use of personal protective measures will help to reduce the risk of many vector-borne diseases. The most important personal protection measures include the use of DEET insect repellent on exposed skin, wearing permethrin-treated uniforms, and wearing these uniforms properly. The use of DEET 33% lotion (2 oz. tubes: NSN 6840-01-284-3982) during daylight and evening/night hours is recommended for protection against a variety of arthropods including mosquitoes, sand flies, other biting flies, fleas, ticks and mites. Uniforms should be treated with 0.5% permethrin aerosol clothing repellent (NSN 6840-01-278-1336), per label instructions. NOTE: This spray is only to be applied to trousers and blouse, not to socks, undergarments or covers. Reducing exposed skin (e.g., rolling shirt sleeves down, buttoning collar of blouse, blousing trousers) will provide fewer opportunities for blood-feeding insects and other arthropods. Additional protection from mosquitoes and other biting flies can be accomplished by the use of screened eating and sleeping quarters, and by limiting the amount of outside activity during the evening/night hours when possible. Bednets (insect bar [netting]: NSN 7210-00-266-9736) may be treated with permethrin for additional protection.

d. Briquettes containing 10% temephos are effective in perennial streams with black fly larvae. Twice-weekly applications of 5% temephos wp at 1.2 g active ingredient to every 50-100m stream with a discharge rate of 0.1-50 l/sec has been effective. This treatment lowered biting densities of *S. ochraceum*, but not *S. metallicum* / *horacioi* complex of black flies.

e. The most important element of an *Aedes aegypti* control program is SOURCE REDUCTION. Eliminating or covering all water holding containers in areas close to human habitation will greatly reduce *A. aegypti* populations. Alternatively, containers may be emptied of water at least once a week to interrupt mosquito breeding. Sand or mortar can be used to fill tree holes and rock holes near encampments.

f. Because the breeding habitats of most sand fly species are not easily identified, not easily accessible, or unknown, control strategies focus mainly on adult sand flies. Peridomestic sand fly species can be controlled by spraying residual insecticides on buildings (including screening on portals of entry) animal shelters, and other adult resting sites. Area chemical control of sylvan sand fly species is impractical. Personal protective measures will reduce sand fly bites and environmental modification (e.g., clearing forests, eliminating rodent burrows/breeding sites, relocating domestic animals away from human dwellings) has been used to reduce local sand fly populations. Fine mesh bednets are recommended in El Peten. DEET is an effective repellent.

6. IMPORTANT REFERENCES:

Contingency Pest Management Pocket Guide - Fourth Edition. Technical Information Memorandum (TIM) 24. Available from the Defense Pest Management Information Analysis Center (DPMIAC) (DSN: 295-7479 COMM:

(301) 295-7479). Best source for information on vector control equipment, supplies, and use in contingency situations.

Control of Communicable Diseases in Man - Edited by A. S. Benenson. Available to government agencies through the Government Printing Office. Published by the American Public Health Association. Excellent source of information on communicable diseases.

Medical Environmental Disease Intelligence and Countermeasures - (MEDIC). September 1997. Available on CD-ROM from Armed Forces Medical Intelligence Center, Fort Detrick, Frederick, MD 21702-5004. A comprehensive medical intelligence product that includes portions of the references listed above and a wealth of additional preventive medicine information.

Internet Sites- Additional information regarding the current status of vector-borne diseases in this and other countries may be found by subscribing to various medical information sites on the internet. At the Centers of Disease Control and Prevention home page subscriptions can be made to the Morbidity and Mortality Weekly Report(MMWR)and the Journal of Emerging Infectious Diseases. The address is www.cdc.gov. The World Health Organization Weekly Epidemiology Report (WHO-WER) can be subscribed to at www.who.int/wer. The web site for PROMED is www.promedmail.org:8080/promed/promed.folder.home.

Although PROMED is not peer reviewed, it is timely and contains potentially useful information. The CDC and WHO reports are peer reviewed. Information on venomous arthropods such as scorpions and spiders as well as snakes, fish and other land animals can be found at the International Venom and Toxin Database website at www.uq.edu.au/~ddb fry/. Information on anti-venom sources can also be found at that site. Information on Poisonings, Bites and Envenomization as well as poison control resources can be found at www.invivo.net/bg/poison2.html.